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#### COLOR RANGE OF COMMON BRICK

As part of a survey of the properties of common brick produced in the United States a record was made of the colors of 3,900 bricks collected from over 200 manufacturers representing all parts of the country.

There is here given a rather generalized description of the color of bricks by district. The following abbreviations are used for the several methods of forming: S. M. (soft mud); D. P. (dry press); S. C. (side cut); and E. C. (end cut).

Name of district	Number of plants	Methods of forming	General color range
Maine, New Hampshire, and Vermont.	9	S. M.	Deep reds and browns with some fawn color and drab.
Massachusetts.	15	S. M. (1 S. C.)	As above. Also medium reds and orange reds.
Connecticut.	12	S. M.	Deep red and deep orange reds to medium reds and orange reds with some browns, fawns, and drabs.
Hudson Valley.	18	do.	Smoked medium reds and medium orange reds. Blotching of dull greens and pinks.
New Jersey.	10	S. M., E. C., S. C.	In part like Hudson Valley, and medium red and orange red on light brown.
Eastern Pennsylvania and Delaware.	20	S. M., S. C.	Dark and medium red and purplish red.
Western Pennsylvania and West Virginia.	10	S. C.	Dark reds, usually dulled with gray. Some dark flashing.
Northern Ohio.	11	S. M., S. C.	Highly variable.
Detroit.	6	S. M.	In part resembles Connecticut, otherwise medium and light red orange.
Chicago.	9	E. C.	Light buff and cream with irregular pinkish markings.
Wisconsin.	6	S. M., S. C.	Pale buff to light cream. Some grades resemble Hudson Valley production.
Kentucky.	6	D. P., S. M., S. C.	Dark reds and purplish reds.
Illinois and Missouri.	12	D. P., S. C.	Medium and dark red and medium red orange. Some dark purplish red.
Nebraska.	5	S. M., S. C.	Medium and light red and red orange with some blue black slag.
Colorado.	8	D. P., S. C.	Medium and light red and orange red. Some cream and brown.
California.	4	S. M., S. C.	Medium red and medium red orange.
Texas.	15	D. P., S. C., E. C.	Light red and light red orange.

Name of district	Number of plants	Methods of forming	General color range
Louisiana and Mississippi.	7	E. P., S. M., S. C., E. C.	Spotting and speckling of black and brown common. Fawns, drabs, browns, medium and dark reds, medium red orange and medium purplish red.
Alabama.	4	D. P., S. C.	Dark, medium, and light red with some medium red orange. Flashes of dark gray and purple gray.
North Carolina.	4	S. C., E. C.	Dark and medium red and red orange with overlay of brown and flashes of drab.
Virginia.	8	S. C.	Dark to light red and red orange.
Maryland and District of Columbia.	7	D. P., S. M., S. C., E. C.	Dark and medium red.

The complete report of this survey will be found in the April issue of the Journal of the Clay Products Institute (% J. A. Pugh, Evans Building, Washington, D. C.).

#### CURING CEMENT UNDER HIGH TEMPERATURES

The steam curing of Portland cement products has been of interest ever since the original experiments several decades ago demonstrated the high early strength that could be obtained. The recent discovery that steam curing was, in general, satisfactory and was the only method of making the products resistant to disintegration by the alkali waters prevalent in the Western States, made the process of still more interest.

There is the unsettled question as to whether all Portland cements will react favorably to the steam curing. Recent experiments by Woodworth (Proc. Am. Concrete Inst., vol. 1, p. 504) included tests in which the steam curing was begun within half an hour after molding instead of after the usual wait of from 18 to 24 hours that permitted the cement to attain an initial strength. The behavior of Portland cements of different characteristics to this type of curing should be of general interest, particularly to the manufacturers, and a short series of tests was undertaken by the bureau.

Four cements were used—a high early strength Portland, one made from Lehigh Valley cement rock, one from marl and clay, and one made from limestone and clay. The tricalcium silicate ranged from 53.5 to 68 per cent, not a wide range, but the minor constituents varied considerably. Mortar specimens, made up with run of mine Ottawa silica sand were prepared, half the specimens being stored in steam, the other half in boiling water. The steam or water curing was continued for 16 hours, the speci-

mens being placed in the steam or water one-half hour after mixing. Comparative specimens were cured in the standard damp closet for 24 hours, then stored in water until tested.

The steam or boiling water curing gave material strength increases at 24 hours, but at 7 and 28 days very little difference in strength was noticeable. It is to be noted that the increase in strength at 24 hours was not similar for all cements.

The detailed description of the tests and the test results will appear in the April, 1932, issue of the Journal of the American Concrete Institute.

#### BASE EXCHANGE CAPACITY OF CLAYS

In connection with the investigation of the properties of several groups of clays the base exchange capacities were worked out.

The total base exchange capacity was determined by electro dialyzing samples in two compartment cells constructed for this type of work, and finding the milliequivalents of hydrogen ions held by the clays in the adsorbed condition, by electrometric titration using Ba(OH)<sub>2</sub> as the neutralizing base.

In correlating the results with physical properties the most interesting relation developed in connection with the dry transverse strength. If the modulus of rupture, in pounds per square inch, is plotted against the milliequivalents of electro dialysable bases per 100 grams of the dry clay, it will be found that the tendency of the plotted points is to form a straight line starting near the origin and having a slope of about 200 pounds per 10 milliequivalents. The china clays form a group near the lower portion of the line, and most of the ball clays at the higher end. The so-called "heavy clays," or those in common use for the manufacture of heavy-clay products, such as face brick, group in between the

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china clays and the balls, tending, in general, to lie fairly high on the line among the ball clays. These latter clays tend to show the poorest correlation due to the large amounts of impurities they carry, or, perhaps, to the wider variation in size of constituent particles. The glacial type clays in particular show higher transverse strength than one would expect from their base exchange capacities.

#### DETERMINATION OF SOIL CORROSIVENESS

The protection of underground pipe lines against soil corrosion divides itself into two phases: (1) The predetermination of where the corrosion will occur, and (2) the choice of proper methods of protection. In a paper presented at the distribution conference of the American Gas Association on April 6 to 8, Scott Ewing, research associate of the American Gas Association at the bureau, reviewed the important evidence collected by organizations and individuals bearing on the value and utility of various methods for determining soil corrosiveness.

Electrical methods for testing the soil, which in their present stage are essentially methods of measuring its resistivity, are the most frequently used in the oil and gas industry. The evidence indicates that the results obtained with this method can be correlated reasonably well with the corrosiveness of western alkali soils, but that the method is not entirely reliable for the soils of the eastern United States, where the corrosion is often largely the result of acid.

Soil survey methods should be an essential part of any corrosion survey, because the classification of the soils along a line makes it possible to study each individual soil. The corrosiveness of each soil can be estimated from resistivity and acidity determinations and from previous experience with this particular type of soil. In most cases, this would be considerably easier and cheaper than depending entirely upon measurements alone to locate the corrosive soils. Mr. Ewing submitted evidence to show that some soil series are uniform in their corrosiveness and appearance, while other soil series have a considerable range in both of these qualities.

#### PROGRESS IN PAPER-TESTING STANDARDS

Progress during the past year in the development of official association

paper-testing methods was reported in February at the annual meeting of the Technical Association of the Pulp and Paper Industry, by B. W. Scribner, chairman of the paper-testing committee.

Noteworthy progress was made by the subcommittees on tests for water resistance and chemical properties. For several years joint laboratory studies of the various methods proposed for testing the water resistance of rosin-sized papers have been carried on by the subcommittee members. The dry-indicator test proposed by Carson was finally chosen as the most suitable method, and under the direction of P. W. Codwise a thoroughly standardized procedure was evolved which he recently recommended for consideration as a tentative association method. The subcommittee on chemical methods, P. F. Wehmer, chairman, completed tentative methods for alpha cellulose, copper number, and total acidity, all of which are particularly important in view of the interest in properties associated with permanence. The alpha-cellulose and copper-number methods are based on those proposed by Rasch and Burton, and the acidity method is essentially that of Kohler and Hall.

A complete procedure for testing unimpregnated roofing felt, comprising tests for saturating properties and modified procedure for fiber composition, in addition to the usual paper tests, was adopted as an official association method. This makes a total of 28 official paper-testing methods so far adopted by the association.

The test development work planned for the current year deals, in addition to further consideration of water resistance and various chemical properties, with printing ink resistance, grease resistance, fiber composition, testing of soap wrappers, and revision of the strength-testing methods.

The report includes mention of suggestions received as to new methods considered desirable of development, and also a résumé of some of the more important developments in general concerning paper testing. The complete report appeared in Paper Mill and Wood Pulp News (February 20, 1932) and Paper Trade Journal (March 3, 1932).

#### OLD ORIENTAL PAPERS

Several old Chinese and Japanese papers composed of paper-making fibers peculiar to the Orient were recently examined at the bureau and

found to be in an excellent state of preservation. These papers are said to date from the fourteenth century.

Three of the papers were composed of paper mulberry, two of mitsumata, and one of bamboo fibers. The use of these fibers dates back to the origin of paper making in China during the first century. The mulberry and mitsumata, which are derived from the inner bark of shrubs, are still used extensively in the Orient for production of tissues characterized by great strength combined with softness. The mulberry papers examined possessed these characteristics, two being tissues and one a very heavy paper. The mitsumata papers were thin, hard papers of high strength. The bamboo paper was thin and soft, but was weak, as would be expected, because bamboo fibers are very similar to those from straw.

The colors of the papers ranged from a cream white to a dark brown. The only sizing material found was starch, which was present in four of the papers. All of the papers had good formation and had strength characteristics similar to those found in newly made papers of these types.

#### PAPER TOWELS

A report of further study of paper towels has been submitted by the bureau to manufacturers and others, for their consideration of a purchase specification for this commodity, developed with their cooperation. Revision of a specification, developed in a similar way several years ago for use of some of the Government departments, was found necessary, because it did not guard against decrease in absorptiveness, which occasionally occurred during prolonged storage.

A preliminary study of 17 samples, representative of the different types, resulted in the development of the following testing procedure, which was used for a second lot of 13 samples, all of which were received shortly after they were manufactured. The towels were tested for weight, bursting strength, tensile breaking strength, fiber composition, absorptiveness, acidity, and resin content. The test for absorptiveness was repeated after heating at 100° C. for periods of ½, 1, 2, and 3 hours, and after storage under normal conditions for periods of 1, 2, 4, and 6 months from date of manufacture.

It was found that the 1-hour heat treatment approximated the 6-months storage period as regards increase in time of absorption of water; therefore

this appears to be a very definite and convenient way of testing the stability of towels in this respect. As the previous tests had shown that the strength did not decrease appreciably in 6-months storage, no further tests of this kind were made. The tensile breaking strength appears to be a better strength criterion than the bursting strength, as the latter gives much more erratic results with this type of material. No constant relation between the desirable qualities of towels and their components was found, but, in general, the better qualities were associated with long, clean fibers and minimum resin and acid contents.

It seems from the test results obtained that weight, tensile breaking strength, and rate of absorption after heating the towels 1 hour at 100° C. are sufficient test requirements for quality, and limits in these respects, defining two grades of towels, were suggested.

#### PERMANENT PHOTOSTAT PAPER

The bureau has cooperated with the Library of Congress and other public libraries in choice of photostat papers for reproducing records in permanent form. Photostat prints are considered to be as permanent as the paper bearing them, provided the sensitizing and printing are done by the best procedure. A large number of foreign and domestic photostat papers have been tested, mainly for the Library of Congress, to determine their suitability for reproducing records of early American history stored in libraries abroad.

This class of paper has been found to compare very favorably with other permanent types, if care has been taken to introduce no excessive amounts of deteriorative chemicals, particularly acid, in the sensitizing treatment. Papers from different sources have shown the following excellent characteristics for permanent records: Free from unbleached or ground wood fibers—weight: 25 by 40 inches, 500 sheets, 64 pounds; folding endurance, over 2,000 double folds in each direction, and retaining over 75 per cent of the folding endurance when heated 72 hours at 100° C.; copper number less than 1.5; alpha cellulose over 90 per cent, and not decreasing more than 2 per cent under the heat test mentioned; acidity less than the equivalent of 0.1 per cent SO<sub>2</sub>. Owing to its great folding strength, paper such as this is particularly suitable for records subjected to much handling. The papers tested showed a

wide range of folding endurance, which in one case was as low as six double folds. However, as many of these in other respects possessed the same characteristics as listed above, they would no doubt be suitable for records which would be handled but little.

In developing the prints, precautions should be taken to avoid excessively high temperature, impure chemicals, and inadequate washing-out of the developer. The test data given are for papers that had been developed.

#### PHOTOGRAPHIC DEVELOPERS

It is well known that the characteristics of photographic emulsions depend to some extent upon the kind of developer and the particular formula by which it is made up. For many years pyrogallol has been much used for sensitometric work. However, for general photography, pyro developers have now been largely replaced by metol-hydroquinone and there is a growing tendency to use the latter in sensitometry as well. The International Congress of Photography is considering recommendations concerning the use of either para-aminophenol or metol-hydroquinone as a standard developer for sensitometric purposes.

A study has been commenced at the Bureau of Standards of the suitability of metol-hydroquinone for this purpose. While not yet completed, some 8 groups comprising 35 formulas have been investigated. The general formula, showing the constituents so far employed and the range of variation of each, is as follows:

	g/liter
Metol -----	0 to 16
Hydroquinone -----	0 to 20
Sodium sulphite -----	10 to 160
Sodium carbonate -----	1 to 100
Potassium bromide (only present in the last group) -----	0 to 2

For each formula, the following characteristics were measured at each of six times of development ranging from 1 to 18 minutes: (1) Contrast, measured by  $\gamma$  (the slope of the straight portion of the characteristic curve); (2) fog density; and (3) sensitivity or speed, measured both by the inertia and by the minimum useful gradient.

In each group, a single ingredient was varied and the changes in the three characteristics were noted.

In the first, the variable was the sulphite content. Increasing the sulphite from 10 to 80 g per liter increased the fog density and decreased values of  $\gamma$ . With 160 g both  $\gamma$  and

fog density were greatly reduced. Since the rapidity with which the developing solution deteriorates decreases as the sulphite content increases, about 20 g per liter were found necessary to preserve the solution at least long enough to carry out the development.

In the second group using this quantity of sulphite, the carbonate content was then varied. Increasing the carbonate increased both  $\gamma$  and fog density for a given time of development (that is, the development was accelerated). A conveniently rapid developer may be obtained with 5 to 10 g per liter. With more than about 50 g, the increase in rapidity is very small.

In the third and fourth groups the same variation of the carbonate was repeated, omitting first the metol and then the hydroquinone. The results demonstrated that the action of these two developing agents in combination can not be predicted from their behavior separately. The hydroquinone developers with less than 50 g of carbonate per liter were not sufficiently rapid, and in all cases the fog density was excessive with long development times; at the same time the sensitivity of the plate was greatly reduced. Neither metol nor hydroquinone produced as high values of  $\gamma$  separately as in combination. Increasing the carbonate content of this metol developer above a minimum (about 5 g per liter) did not affect the rapidity of development. For the fifth group, the fourth was then repeated using 8 g (4 times the previous quantity) of developing agent. It was still impossible to attain the maximum value of  $\gamma$  obtained with the metol-hydroquinone combination.

In the sixth and seventh groups, the ratio of metol to hydroquinone was varied. In one, the metol was kept constant while the hydroquinone was varied. Increasing the hydroquinone (above 5 g per liter) resulted in moderately lower values of fog density at all development times and somewhat higher values of  $\gamma$  at the long times. In the other, the hydroquinone content was fixed and the metol varied. Increasing the metol (about 2 g), increased the fog density slightly, but did not increase the maximum value of  $\gamma$  obtainable.

In all of these seven groups, the developers were without potassium bromide. The eighth group was concerned with the effect of additions of this constituent. As the bromide was increased, values of  $\gamma$  and sensitivity



were greatly reduced with short times of development, while with prolonged development both characteristics were considerably increased. The fog density at all times of development varied inversely with the bromide content.

#### FURTHER STUDIES OF PHOTOGRAPHIC EMULSIONS

The April number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH will contain a report on the bureau's investigations of photographic emulsions, following several which have already appeared in the Journal.

The report is introduced by discussions of previous experimental and theoretical work on silver and hydrogen ion concentrations in emulsions, and a description of experimental technique. These variables are taken up first according to their effects on after-ripening, and second according to their direct effects on sensitivity when changes in after-ripening are eliminated (in experiments after digestion). The rate of after-ripening increases with increasing silver ion concentration and increasing pH; the corresponding effects on sensitivity are much larger than those produced by the direct effect on environment (after digestion). The combination of silver ion with gelatin reduces the effect of excess silver; illustrations are given for the distribution of excess bromide or silver in the emulsion with changing pH. The desensitizing action of bromide (after digestion) is found to increase with increasing acidity; conversely, the effect of pH is dependent on the silver ion concentration. Spectral sensitivity of the emulsions is found to be independent of hydrogen or silver ion concentrations; these variables must, therefore, influence sensitivity through secondary reactions in latent image formation. Results are discussed in terms of a new concept of the adsorption of gelatin to silver bromide, based on the "zwitterion" theory of ampholytes.

#### OPTICAL REQUIREMENTS OF INSTRUMENTS FOR AIRPLANE MAPPING

When the first airplane photographs were made it was realized that these photographs might be used for the construction of maps. The earliest maps constructed by this means were made by matching the successive photographs and pasting them on a large mount. These maps, termed mosaics, are still used for some purposes but they are not true maps, and distances scaled from them are likely to show large errors which arise from the un-

even character of the territory mapped and from the unavoidable lack of constancy in the altitude and tilt of the airplane during the time the exposures are made.

Accurate maps, showing not only the horizontal projection of the surface mapped, but also the elevation of all parts, can be constructed from airplane photographs by the use of modern apparatus, and this application is rapidly gaining importance in connection with hydroelectric installations and in the usual routine civil mapping by some Government departments. Airplane mapping is particularly effective in mapping wooded or very rugged areas where a ground survey can be made only with considerable difficulty and expense.

The optical requirements of the instruments employed in this work will be discussed in the April number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

If it is assumed that no errors are introduced by the instruments and operations by which the negatives for map making are measured, and if accepted values for the limit of resolution of the photographic emulsion are used, it is pointed out that one can deduce exact general relations between the precision of the ideal resulting map and constants relating to the photographic work, such as height of airplane, focal length of lens, the freedom from aberration of the lens, etc. The extent to which actual performance in mapping project falls short of this ideal performance is a measure of the present limitations of the instruments used for measuring the negatives and producing maps. Furthermore, the general relations which are derived indicate the great value and importance of developing a photographic objective which has a very large field of view, together with substantial freedom from distortion.

#### INFRA-RED SPECTRA AND IDENTIFICATION OF FRAUNHOFER LINES

The discovery of new infra-red sensitizers by the Eastman Kodak research laboratories makes it possible to record spectra photographically considerably beyond the former limit. In fact, the infra-red range now accessible to photography has been more than doubled. The infra-red spectra of 40 chemical elements have now been explored with these new plates, and in most cases many new lines have been discovered. These new data make it possible to confirm and extend the analyses of spectral struc-

tures and thus verify the theory of atomic structure.

Our knowledge of the chemical constitution of the sun is based on the identification of spectral lines characteristic of the chemical elements in the laboratory with the dark (Fraunhofer) lines observed in the solar spectrum. The presence of 57 chemical elements in the sun's atmosphere has thus been established. More than 20,000 dark lines have been charted in the solar spectrum, but less than 12,000 of these have been identified with known spectra. The remainder are mostly faint lines and many of these will be explained when the laboratory data on emission spectra become more complete. For example, practically all of the new infra-red lines observed for iron and silicon in the laboratory have also been found in the sun. The case of silicon is of special interest because it is one of the most abundant elements in the sun, but its spectrum is characterized by a relatively small number of lines. The number of silicon arc lines identified with solar lines has now been increased from 27 to 50, and includes the strongest Fraunhofer line heretofore unidentified.

#### INTERNATIONAL COMPARISON OF STANDARDS OF CAPACITANCE

In order to determine the difference, if any, in the standards of electrical capacitance at the Bureau of Standards and the National Physical Laboratory of England, a subdivided mica capacitor has been alternately measured at the two laboratories. The capacitor has been transported four times, with five sets of measurements at the bureau and two sets at the National Physical Laboratory. During the first transportation appreciable changes occurred in the capacitances, but during subsequent transportation no appreciable changes occurred.

The methods of measurements at the two laboratories were quite different. At the bureau the capacitance of each section was compared either directly or indirectly with an air capacitor, the capacitance of which was determined in terms of resistance and time. The assumption is made that the capacitance of the air capacitor is independent of the method of measurement and that its power factor is zero. This method requires two bridges, one an alternating current bridge for comparing the mica capacitor with an air capacitor at any desired frequency, the other a direct current bridge with a commutator in

one arm for charging and discharging the air capacitor. At the National Physical Laboratory the capacitance was compared by means of an alternating current bridge of the Carey-Foster type with a standard mutual inductance, the value of which could be computed from its dimensions. The assumption was made that a sinusoidal current in the primary of the mutual inductance induces an electromotive force in the secondary which is  $90^\circ$  ( $\pi/2$  radians) different in phase from the current in the primary.

The results of the measurements on both capacitance and power factor agree within the experimental error, which is 1 or 2 parts in 10,000 for the capacitance and 1 or 2 in the fourth decimal place for the power factor. This agreement is quite as good as can be obtained with a capacitor having the stability of the instrument tested. A more accurate check must await the construction of a more permanent capacitor.

A more complete account of this work will be published as Research Paper No. 431 in the April number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

#### RADIO FIELD INTENSITY MEASUREMENTS

Radio field intensity measurements form an accurate basis for estimates of the effectiveness of broadcasting stations, since this is known to be proportional to the square root of the power used. However, the relations between effectiveness, frequency, and distance are much more complicated and may only be determined in practice by means of measurements of field intensity. Thousands of measurements of daytime field intensities have been made by the bureau at various distances from broadcasting stations in the eastern part of the United States. These measurements form the basis for estimates of the effectiveness at various distances of stations broadcasting on different frequencies; it was found that halving the frequency increases the effectiveness about five times for the same power and at the same distance; stations near Chicago were found to be about five times as effective as stations near New York using the same power and frequency. The measurements were found to be in good agreement with a theory given by Sommerfeld as early as 1909. With the aid of this theory, it was possible to estimate the daytime effectiveness of any broadcasting station east of

Chicago and at any distance from the station, and this has now been prepared in the form of a graph. The complete report on this work will be published in the April number of the BUREAU OF STANDARDS JOURNAL OF RESEARCH.

#### AIRPLANE RECEIVING EQUIPMENT FOR VISUAL RADIO RANGE BEACONS

Radio is used in two principal ways as an aid to air navigation. One of these is communication and the other is directional guidance. On the airways of this country, directional guidance takes the form of radio range beacon stations which send out direction signals which enable the airplane pilot to navigate the established course along the airway without the use of directional apparatus aboard the airplane.

The bureau, serving as the research division of the Aeronautics Branch of the Department of Commerce, continuously carries on research for the improvement of this and other radio aids to air navigation. The radio range beacon is now available in two forms, one in which a signal is received aurally by the airplane pilot, and one in which a visual indication on the airplane instrument board tells the pilot whether he is on course or off to the right or the left. The visual indicators and associated equipment have become commercially available. Airplane operators and others have expressed a desire for information on the installation and use of such equipment. To meet this, the bureau has prepared a complete set of specifications entitled "Airplane Receiving Equipment for Visual Radio Range Beacons," which is available gratis to operators of airplanes or anyone interested, upon request addressed to the bureau. This includes information on receiving sets, reed indicators, pointer type indicators, combined course and volume indicating instruments, and an installation wiring diagram.

General information on the visual radio range beacon system is given in Bureau of Standards Research Paper No. 159, "Development of the Visual Type Airway Radio Beacon System," obtainable from the Superintendent of Documents, Washington, D. C., for 20 cents. To secure satisfactory operation of any radio receiving equipment on most airplanes, it is necessary that the engine and all electrical equipment be carefully shielded and the airplane structure bonded. Detailed specifications for shielding and bonding are given in Appendixes 1 and 2 of "Sec-

ond Report of Liaison Committee on Aeronautic Radio Research"; this publication is obtainable gratis upon request addressed to Aeronautics Branch, Department of Commerce, Washington, D. C.

Technical information on other phases of the airplane receiving equipment for the visual radio range beacon system is given in the following publications, obtainable from the Superintendent of Documents, Washington, D. C., at the prices stated: RP330, "Automatic Volume Control for Aircraft Radio Receivers," 10 cents; RP28, "Design of Tuned-Reed Course Indicators for Aircraft Radio Beacon," 5 cents; RP160, "A Tuned-Reed Course Indicator for the 4 and 12 Course Aircraft Radio Range," 15 cents; RP338, "Theory of Design and Calibration of Vibrating-Reed Indicators for Radio Range Beacons," 10 cents; RP336, "A Course Indicator of Pointer Type for the Visual Radio-Range Beacon System," 15 cents.

#### NEW AND REVISED PUBLICATIONS ISSUED DURING MARCH, 1932

##### Journal of Research<sup>1</sup>

Bureau of Standards Journal of Research, title page to vol. 7, July to December, 1931 (RP Nos. 329 to 395, inclusive). Free on application to the Bureau of Standards.

Bureau of Standards Journal of Research, vol. 8, No. 2, February, 1932 (RP Nos. 407 to 415, inclusive). Price, 40 cents. Obtainable by subscription.

##### Research Papers<sup>1</sup>

##### (Reprints from Journal of Research)

RP387. The life of the sagger as affected by varying certain properties, R. A. Heindl and L. E. Mong. Price, 10 cents.

RP394. Tests of integral and surface waterproofings for concrete, C. H. Jumper. Price, 10 cents.

RP396. The preparation of crystalline methyl-*d*-guloses by means of co-ordination compounds with calcium chloride, H. S. Isbell. Price, 5 cents.

<sup>1</sup> Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 40 cents. Subscription to Journal of Research, \$3 per year; other countries, \$3.75. Subscription to Commercial Standards Monthly, \$1 per year; other countries, \$1.25.



RP397. International comparison of X-ray standards, L. S. Taylor. Price, 10 cents.

RP399. A method for determining the volume changes occurring in metals during casting; C. M. Saeger, jr., and E. J. Ash. Price, 10 cents.

RP400. Registration of cathode rays by thin films of metals and metal compounds, W. W. Nicholas and C. G. Malmberg. Price, 5 cents.

RP402. Ultrasonic measurements of the compressibility of solutions and of solid particles in suspension, C. R. Randall. Price 10 cents.

RP403. On elimination of liquid contact potentials with potassium chloride and ammonium chloride, G. M. Kline, M. R. Meacham, and S. F. Acree. Price, 5 cents.

RP404. An electrostatic voltmeter, W. W. Nicholas. Price 5 cents.

RP406. A clock-controlled constant-frequency generator, A. B. Lewis. Price, 10 cents.

Commercial Standards Monthly<sup>1</sup>

Commercial Standards Monthly, vol. 8, No. 9, March, 1932. Price, 10 cents. Obtainable by subscription.

Technical News Bulletin<sup>1</sup>

Technical News Bulletin No. 179, March, 1932. Price, 5 cents. Obtainable by subscription.

OUTSIDE PUBLICATIONS<sup>2</sup>

Solar activity and radiotelegraphy, L. W. Austin, Institute of Radio Engineers (New York, N. Y.), vol. 20, No. 2, p. 280, February, 1932.

A radio system for flying and landing aircraft in fog, H. Diamond and F. W. Dunmore, Aeronautical Engineering (American Society of Mechanical Engineers, New York, N. Y.), p. 13, January-March, 1932.

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<sup>2</sup> "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

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The first of these was the discovery of gold in California in 1848. This discovery led to a great influx of people to California, and the state became a great center of population. The second was the discovery of gold in Nevada in 1859. This discovery led to a great influx of people to Nevada, and the state became a great center of population. The third was the discovery of gold in Colorado in 1858. This discovery led to a great influx of people to Colorado, and the state became a great center of population. The fourth was the discovery of gold in Idaho in 1860. This discovery led to a great influx of people to Idaho, and the state became a great center of population. The fifth was the discovery of gold in Montana in 1862. This discovery led to a great influx of people to Montana, and the state became a great center of population. The sixth was the discovery of gold in Wyoming in 1869. This discovery led to a great influx of people to Wyoming, and the state became a great center of population. The seventh was the discovery of gold in Utah in 1871. This discovery led to a great influx of people to Utah, and the state became a great center of population. The eighth was the discovery of gold in Arizona in 1873. This discovery led to a great influx of people to Arizona, and the state became a great center of population. The ninth was the discovery of gold in New Mexico in 1875. This discovery led to a great influx of people to New Mexico, and the state became a great center of population. The tenth was the discovery of gold in Texas in 1877. This discovery led to a great influx of people to Texas, and the state became a great center of population.

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